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XX.—*On some Peculiarities in the Geographical Distribution and in the Habits of certain Mammals inhabiting Continental and Oceanic Islands**. By G. E. DOBSON, M.A., F.R.S.

THE geographical distribution of Mammals inhabiting continental and oceanic islands has been lately so ably treated of by Mr. Wallace, in his work 'Island Life,' that I do not purpose entering upon the subject from a general point of view, but will limit my remarks to some peculiarities of distribution which have attracted my attention while engaged in the special study of certain Mammalian orders: I refer particularly to the Chiroptera and Insectivora.

It is an interesting fact, not hitherto noticed, that many of the most characteristic species of the Chiropterous fauna of Australia have their nearest allies, not in the Oriental, but in the Ethiopian Region, thus contrasting remarkably with the avifauna. The peculiar genus *Chalinolobus* is represented only in Africa south of the equator and in Australia, a single species extending into New Zealand. Again, the species of the subgenus *Mormopterus*, which belongs to a genus (*Nyctinomus*) of world-wide distribution, are limited to the same

* Read before the Biological Section of the British Association for the Advancement of Science at the Montreal Meeting, August 29, 1884.

zoological regions, being found only in Africa south of the equator, Madagascar, the Mascarene Islands, Australia, and Norfolk Island. The presence of a species of this genus in Norfolk Island and its absence from New Zealand is very remarkable, for, as I pointed out for the first time about ten years ago, one of the two known New-Zealand bats, namely *Chalinolobus tuberculatus*, is also common in Australia.

The species of the extraordinarily specialized genus *Megaderma* have their head quarters in the Oriental and Ethiopian regions; yet the largest species, not only of the genus, but also of all known insectivorous bats, namely *M. gigas*, lately described by the writer from Central Queensland, has its nearest ally, not in any of the Oriental species, but in *M. cor* from Eastern Africa. Another very remarkable leaf-nosed bat, the type of my genus *Tricenops*, found in Madagascar, Eastern Africa, and Persia, but unknown in the well-searched Oriental region, has its nearest and only ally in *Rhinycteris aurantia* of Australia, the type of another very peculiar genus. Finally, Australia agrees much more closely with Madagascar and the Mascarene Islands than with the Oriental region in the species of the large genus *Pteropus*, for, while species of the section of which *Pt. vulgaris* of Madagascar is characteristic are well represented in the former regions, they are absent from the latter. Furthermore it is noticeable that, while 80 per cent. of the species of the genus inhabit the Australian region and Madagascar with its islands, a single species only has found its way to the great continent of Hindustan and to Ceylon.

How can we account for this resemblance of the Australian and Ethiopian regions in certain very peculiar species of bats while their birds differ so conspicuously?

In the first place, to account for the presence of closely related species in both continents, it is necessary to postulate the existence of some land connexion, not necessarily continuous, between them; but that such connexion was not by way of India appears evident from the absence of such species in that country or in the islands connecting it and the Malay peninsula with Australia.

We are therefore obliged to suppose that at a comparatively recent period a chain of islands connected these continents, the islands being sufficiently far apart to prevent the entrance of terrestrial mammals, yet near enough to permit of the occasional passage of some of the flying species; still it must be remembered that, in estimating such distances, the narrow strait between the Comoro Islands and the coast of Africa, about 180 miles wide, has sufficed to limit the western distri-

bution of the flying-foxes, for not a single species of *Pteropus* is known from Africa, though they abound in Madagascar and the Comoro Islands. On the other hand, the insectivorous bats, with much greater powers of flight, are very similar in Madagascar and Africa.

But it may be urged that such propinquity of islands to one another and to these continents would also permit interchange of the avifaunas.

To this the following reply may be made:—That the existence of a complete chain of islands separated by sufficiently narrow straits may have existed for a short period only, the completeness of the chain being, perhaps, dependent on some volcanic group, which may have disappeared as suddenly as it came into existence. Under such circumstances bats would be much more likely to establish themselves successfully in the new continental lands open to their migrations for the following reasons:—(1) that the food of both the frugivorous and insectivorous species is of a more general character than that of birds, few of the species of which are so omnivorous, within these limits, as the bats; (2) that the nocturnal habits of the bats would enable them to escape observation from enemies always sure to recognize the presence of solitary individuals.

It may now be urged that if we acknowledge the effect of such circumstances in favouring the distribution of bats, we ought then to expect to find more bats than birds in all oceanic islands. Such an objection may be easily disposed of when it is remembered that volant insects are very scarce in all oceanic islands, whereas they are abundant in all continents, and, furthermore, that a straggling bird on arrival at an oceanic island would encounter far fewer enemies than it would meet in a continent, and, owing to its power of seeking its food on foot as well as on wing, would also be much more likely to survive than the thoroughly aerial bat.

It is, I believe, to a great extent, on this very principle, that the Chiropterous fauna of New Zealand is so limited; that, as yet, two species of bats only, represented apparently by few individuals, are known from these islands, while in the British Isles, which about equal them in extent, there are eight times the number of species, and, probably, a far greater proportion of individuals. The striking paucity of winged insects which, in other countries of corresponding climate, form wholly the food of the bats, has evidently, in a great measure, not only caused this remarkable difference, but, as I pointed out some years ago for the first time, has led to a change in the structure of one of the two species comparable

to that of no other species of bat. This species, *Mystacina tuberculata*, has the claws of the pollex and toes remarkably elongated, very acutely pointed, and provided at the base of each with a small talon projecting from its concave surface near the base; the wings are peculiarly folded so as to occupy the least possible space, and they and the interfemoral membrane are preserved from injury by being encased, when so folded, in a specially thickened part of the wing and interfemoral membrane, analogous to the thickened part of the anterior wings in Hemiptera and to the elytra of the Coleoptera; furthermore, the plantar surface of the foot, including the toes, is covered with very soft and very lax integument deeply wrinkled, and each toe is marked by a central longitudinal groove, with short grooves at right angles to it, as in the species of the Gecko genus *Hemidactylus*. All these peculiarities of structure must accompany some corresponding peculiarities in the habits of this species. There can be little doubt that the denticles at the bases of the claws of the thumbs and toes give additional grasping-power to these organs, and this, taken into consideration with the peculiar manner in which the wings and interfemoral membrane are protected from injury when not employed in flying, and with the manifestly adhesive nature of the sole of the foot and inferior surface of the legs, leads me to believe that this species hunts for its insect food, not only in the air, but also upon the branches and leaves of trees, among which its peculiarities of structure most probably enable it to climb with security and ease.

The insect food of this species consists chiefly, in all probability, of the Longicorn beetles and Carabidæ, which form so large a proportion of the New-Zealand insect-fauna, and are found on and under the bark of trees. In searching for these the peculiarly mobile projecting snout is, no doubt, actively employed, while the very large scalpriform incisors are evidently most effective in seizing and crushing them. In fact, this quasi-terrestrial bat represents the only arboreal insectivorous mammal in the islands, and probably takes also the place of the insectivorous woodpeckers.

To return to the distribution of the species of the widely spread large genus *Pteropus*, with more than forty species, including the great frugivorous bats, of which *Pt. edulis* (inhabiting Java and adjacent islands) measures 5 feet in expanse of wings. These bats, as I have already remarked, have their head quarters in Australia and in Madagascar and the Mascarene Islands. It is a noticeable fact that, although the small islands of Mauritius, Bourbon, and the Comoro

group have each two very distinct species, the great continent of India and Burma and the island of Ceylon has but one*. It appears probable, therefore, that India owes its single flying-fox to some other region, and, in seeking for the country from which it is derived, we must consider its nearest allies among the species of the genus.

Now this species differs from *Pt. Edwardsii* of Madagascar and the Seychelle Islands in few and unimportant characters, presenting such differences only as might have resulted in a few generations, though they now appear to be permanent. It is therefore evident that these two species have been derived within a comparatively recent period from a common ancestor, and probable that the enormous number of individuals of *Pt. medius* now representing the genus in India are the descendants of a few individuals originally escaped from their island homes in the Indian Ocean, and now cut off by subsidence of some of these islands from their nearest relations. On no other hypothesis can we account for the discontinuous distribution of the species of this genus, for, as we have seen, the narrow channel of Mozambique between the Comoro Islands and the coast of Africa has sufficed to prevent their entrance into Africa, where tree-fruit is abundant and where immense numbers of fruit-eating bats of other and of allied genera abound. Indeed it is difficult to imagine one of these great bats, whose flight appears so slow and laboured compared with that of all other species of Chiroptera, traversing 50, much less 500, miles of unbroken sea; for even if carried out to sea by a storm, their wings would evidently collapse long before they had travelled half the distance. On

* That this is not due to deficiency of food the following note by Dr. J. Anderson, F.R.S., abundantly proves, for it shows what prodigious numbers of individuals of this one species (*Pt. medius*) inhabit the country:—"This species has been flying for the last few days from the north to the south of the city (Calcutta), in immense numbers, immediately after sunset. The sky, from east to west, has been covered with them as far as the eye could reach, and all were flying with an evident purpose, and making for some common feeding-ground. Over a transverse area of 250 yards, as many as seventy bats passed overhead in one minute; and as they were spread over an area of great breadth and could be detected in the sky on both sides as far as could be seen, their numbers were very great, but yet they continued to pass overhead for about half an hour. This is not the first time I have observed this habit in this species; indeed it was more markedly seen in August 1864, while I was residing in the Botanical Gardens, Calcutta. The sky, immediately after sunset, was covered with this bat, travelling in a steady manner from west to east, and spread over a great expanse, all evidently making for one goal, and travelling, as it were, like birds of passage, with a steady purpose." ('Catalogue of Mammalia,' Indian Museum, Calcutta, pt. i. p. 101: 1881.)

the other hand, it is quite out of one's power to understand their present distribution, except on the old grounds of independent creation, without postulating a much closer connexion, than Mr. Wallace appears disposed to admit, between the island groups in the Indian Ocean at a comparatively recent period.

The above-noted facts lead to the following deductions, namely, that, in the first place, a chain of islands sufficiently close to allow of the passage, not only of the representatives of the genera of insectivorous bats referred to, but also of the large slow-flying frugivorous bats, must have existed between Madagascar and Australia; and, secondly, that, at a later period, a temporary connexion of a similar kind lay between Madagascar and India.

It may be said that such connexion with India would also permit of the introduction of insectivorous bats; but it must be again remembered that volant insects, on which such bats feed, are very scarce in oceanic islands, while tree-fruit, which forms the food of the frugivorous species, is usually abundant. Bearing these facts in mind, it is necessary to suppose that the islands, assumed to have formed the high road for the insectivorous bats between Africa and Australia, must have been sufficiently large to support volant insects; while, on the other hand, a chain of small coral islands, placed not too far apart, and provided only with a few fruit-bearing trees, would have sufficed for the passage of the frugivorous species; and it appears more than probable that it was by such a chain that the ancestors of the flying-foxes of India were introduced into that continent.

While considering the former geographical relations of these regions it may be well to refer to an apparently most remarkable instance of discontinuous distribution which long puzzled zoologists—namely, the supposed close relationship between the Insectivora of Madagascar and the West Indies, depending upon the presence, in the islands of Cuba and Hayti, of one or more species of the genus *Solenodon*, which was said to belong to the family Centetidæ, known elsewhere in Madagascar only. Mr. Wallace partly gets over the difficulty by referring to supposed remains of species of this family in France in strata believed to be of Lower Miocene age; but this was hardly necessary, for, as I have lately pointed out*, *Solenodon* belongs to a family less closely related to Centetidæ than the Hedgehogs (Erinaccidæ) are to the Moles (Tal-

* 'Monograph of the Insectivora, Systematic and Anatomical,' pt. i. p. 87.

pidæ) or to the Shrews (*Soricidæ*), and no zoologist has ever suggested the union of these families. The supposed close relationship depends therefore on faulty estimation of the natural affinities of these animals.

Two species of bats, *Vesperugo noctivagans* and *Atalapha cinerea*, inhabit the Bermudas, while one only, *Vesperugo Leisleri*, is known in the Azores, and its presence there is less remarkable, seeing that the latter islands are distant about 550 miles from Madeira, where this species is also found, while the former are nearly 700 miles from the American coast. The presence of these animals in both groups of islands has been attributed to violent storms; and it is worthy of notice, as tending to bear out the correctness of this theory, that the Azorean species resembles the American species inhabiting the Bermudas in the robustness of its bodily structure and in the hairiness of its wing and interfemoral membranes—qualities which would endow the animals possessing them with greater powers of resisting fatigue and of enduring the chilling effects of high winds at probably a great elevation.

XXI.—*Moas and Moa-hunters*. By A. DE QUATREFAGES.

[Concluded from page 141.]

IV.

AT the same time that he clearly distinguished the *Moa-hunters* from the *Maoris*, Dr. Haast asserted that the former confined themselves to roughly chipping their stone implements, while the latter knew how to give them a polish, of which we can judge from numerous specimens*. He added that the Moa-hunters did not possess weapons in nephrite, that is to say, fabricated out of a kind of stone often confounded with jade, to which the islanders found in New Zealand by European navigators attached a special value†.

These two propositions were of very great importance in connexion with the theory maintained by the New-Zealand naturalist. They tended to establish a further agreement with what took place in Europe. It is well known that the *chipped hache* and the *polished hache* are among the characteristic traits which, among us, distinguish two epochs. It is also well known that the populations of these two epochs belonged

* Sixth proposition, p. 140.

† Second proposition, p. 140.